Prior Publication Productivity, Grant Percentile Ranking, and Normalized Citation Impact of NHLBI Cardiovascular R01 Grants

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Disclosures: None

Background

- Identifying factors that predict scientific impact of grants may help inform a more empirical approach to funding decisions.
- Our previous work demonstrated a lack of correlation between peer review derived grant percentile ranking and scientific impact in a large cohort of National Heart, Lung, and Blood Institute (NHLBI)-funded cardiovascular R01 grants. (Danthi et al. *Circ Res*. 2014)
- Investigator prior publication productivity was not evaluated.

Objectives

- To test the hypothesis that measures of investigator prior performance correlates with scientific impact as measured by citation metrics.

Methods

- We identified 1492 investigator-initiated de novo NHLBI R01 grants funded between 2001 and 2008
- Publications from grants were linked to their "InCites™" (Thompson Reuters) citation record
  - InCites™ provides a normalized citation count for each publication stratifying by year of publication, type of publication, and field of science.
  - Counts of publications and citations were adjusted by dividing by number of cited grants.
- Primary bibliometric endpoints:
  - Normalized citation impact score per million dollars allocated
  - Number of top 10% publications per million dollars allocated
- Primary predictors
  - Investigator prior productivity (number of NHLBI-supported publications in the 5 years prior to the grant start date)
  - Grant peer-review percentile score.

Methods

- Statistical analysis
  - To describe the association of bibliometric outcomes with measures of prior productivity and percentile, we computed and plotted nonparametric locally weighted scatterplot smoothing estimates.
  - Multivariable linear regression analyses were performed to determine associations with bibliometric outcomes. Covariates listed in Table 1.
  - Breiman random forests were constructed to further evaluate the independent association of prior productivity measures with bibliometric outcomes.
  - We repeated the analysis on a random sample of 100 grants, using all prior publications, regardless of funding support, in the 5 year period prior to the grant start date.

Results

•The 1492 grants yielded 19,260 publications through December 2013; of these, 5534 (29%) were top-10% papers.

Table 1. Grant and applicant characteristics and bibliometric outcomes from 1492 cardiovascular R01 grants

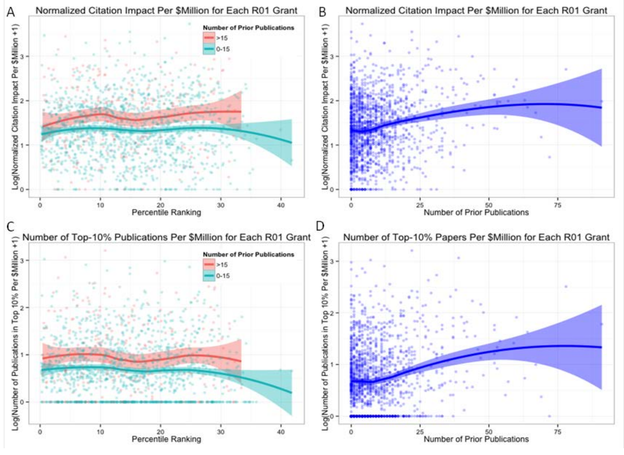
	Prior Publication Counts			
	≤ 3	4 - 10	> 10	p value
Number of grants	535	480	477	
Applicant prior productivity				
Prior publications	0/1/2	5/6/8	13/17/24	<0.001
Prior number of grants	0/1/3	1/2/4	1/3/5	<0.001
Prior grant funding, $mn	0.00/0.42/1.57	0.12/0.98/2.60	0.56/2.68/6.87	<0.001
Grant characteristics				
Percentile	8.7/15.1/21.7	7.6/13.9/21.2	7.2/13.5/19.5	0.014
New investigator	44% (236)	27% (130)	16% (76)	<0.001
Human studies	38% (201)	32% (152)	32% (155)	0.096
Total funding, $mn	1.27/1.65/2.68	1.32/1.69/2.71	1.42/1.83/2.97	0.006
Duration, y	5.0/5.8/7.6	5.0/5.9/7.7	5.0/5.9/8.4	0.32
Annual funding, $mn/y	0.24/0.29/0.36	0.24/0.29/0.36	0.26/0.31/0.39	<0.001
Institutional funding in portfolio, $mn	10.86/28.82/43.83	13.77/30.55/42.95	15.56/32.66/45.27	0.026
Bibliometric outcomes for each grant				
Number of publications	4.0/8.0/15.0	4.3/8.0/13.5	6.0/11.3/21.0	<0.001
Normalized citation impact	2.1/5.0/9.8	2.5/5.1/9.1	3.7/7.2/13.6	<0.001
Number of top 10% publications	0.0/1.3/4.0	0.0/1.3/4.0	1.0/2.3/6.0	<0.001
Normalized citation impact per $mn	1.3/2.8/5.3	1.5/2.8/4.9	2.0/3.8/6.5	<0.001
Number of top 10% publications per $mn	0.0/0.8/1.9	0.0/0.8/1.7	0.4/1.3/2.7	<0.001

Values shown are 25th%ile/median/75th%ile or percentile (number); $mn, million dollars

Results

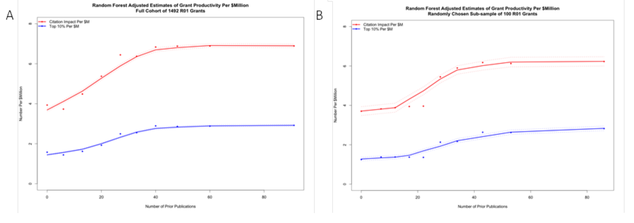
- There was no association between peer-review percentile ranking and bibliometric endpoints (adjusted P > 0.5, Fig. 1A and 1C).
- Number of prior NHLBI-supported publications was predictive of bibliometric endpoints (adjusted P < 0.0001, Fig. 1)

Figure 1. Bibliometric endpoints according to percentile ranking and number of prior NHLBI publications for 1492 R01 grants (LOWESS fits)



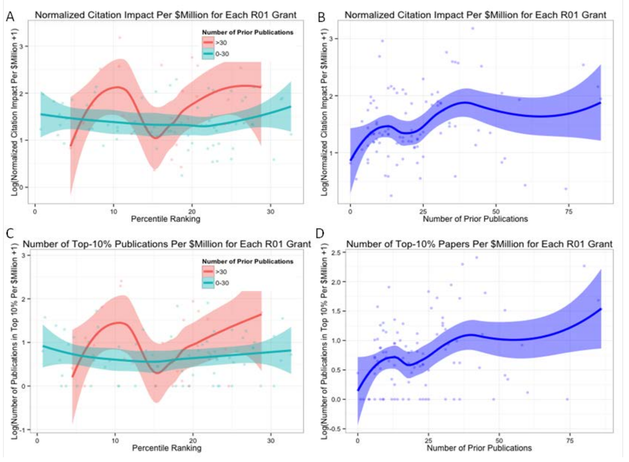
- Machine learning Breiman random forest models demonstrated that the number of prior NHLBI-supported publications was a strong predictor of the bibliometric endpoints (Fig. 2).

Figure 2. Random forest findings (association of bibliometric endpoints and number of prior publications after accounting for all covariates)



- A repeat analysis, on a random subset of 100 grants, confirmed our findings that number of prior publications was predictive of the bibliometric endpoints (adjusted P<0.05, Fig. 3 and Fig. 2B).

Figure 3. Bibliometric endpoints according to percentile ranking and number of prior total publications for random sample of 100 grants (LOWESS fits)



Limitations

- Citations provides an incomplete picture of scientific impact.
- Additional confounders that we were unable to consider, such as institutional environment, mentorship, and collaborators, may also influence future scientific impact.

Conclusions

- This extended analysis of previous work confirmed a lack of association between peer-review grant percentile ranking and grant citation impact, this time even after considering scientific field, article type, and year of publication.
- We also demonstrated that prior investigator publication productivity was predictive of grant-specific citation impact.